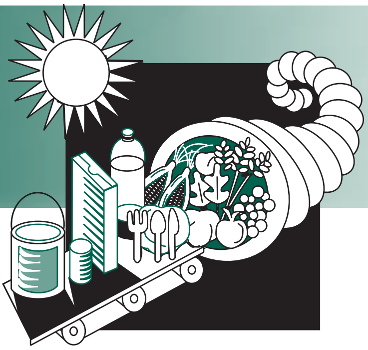
AGRICULTURE

Project Fact Sheet

New Continuous Isosorbide Production from Sorbitol



Benefits

- Reduces petroleum feedstock use
- Boosts U.S. farming economy
- Increases catalyst selectivity while minimizing by-product formation and extending catalyst lifetime
- Potential 2020 sPET market is 1 billion lb per year
- Potential 2020 isosorbide market is 100 million lb per year

Applications

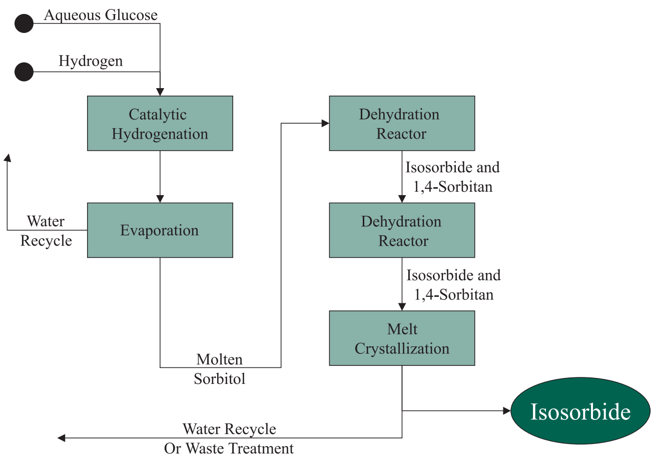
The use of isosorbide as a polymer additive offers enhanced material properties while reducing the use of petroleum feedstocks. The increased strength and rigidity of sPET can reduce the overall amount of plastics such as PET by providing the same strength while using less material.

Addition of Biobased Isosorbide to Polyethylene Terephthalate (PET) Increases Strength and Rigidity of Polyethylene Tetephthalate

Interest in the production of isosorbide has been generated by recent discoveries of the effects of co-polymerizing isosorbide with polymers such as polyethylene terephthalate (PET). When isosorbide is added to PET, the co-polymer, sPET, is stronger and more rigid than the original PET. PET is used in a variety of food and beverage containers with a current market of 4.4 billion pounds. If it were displaced by sPET, the amount of petroleum-derived PET could be reduced. The added strength could also allow container manufacturers to redesign containers to use less material while meeting the same strength standards, thus reducing the overall use of PET.

The use of biobased isosorbide as a polymer additive has the potential to reduce the amount of petroleum feedstocks used in the polymer industry, lower emissions (e.g., carbon dioxide), and offer a higher value-added alternative for corn growers and other agribusinesses. However, to realize these benefits a cost-effective process to convert renewable resource-derived sorbitol to isosorbide must be developed. Several patents have been filed in the synthesis of isosorbide from sorbitol, but these processes use catalysts that promote the formation of unwanted by-products and carry out the reaction in an organic solvent. This project seeks to develop an economically-viable, continuous catalytic process to convert sorbitol, an alcohol which can be derived from biomass sugars, to isosorbide with high yields using novel heterogeneous catalysts. The catalysts will be capable of achieving greater than 95% selectivity while minimizing by-product formation and have a lifetime of at least one year.

Production of Biobased Isosorbide



Project Description

Goal: To develop a renewable route to isosorbide using solid acid catalysts that is economically attractive.

The research will be divided into three areas: 1) new solid acid catalyst system development based on shape-selective catalysts; 2) design of an overall process that is solvent free (or uses a benign solvent) and has a selectivity to isosorbide at greater than 95%; and 3) demonstration of process at the bench-scale and the pilot-scale for commercialization. The first two areas will be led by the Pacific Northwest National Laboratory (PNNL) with the Iowa Corn Promotion Board (ICPB) performing the process economics evaluation that will direct the research in all three areas. ICPB will also provide the industry partnerships, economic analyses, and business plans required to commercially deploy the new technology.

Solid superacid catalysts will be investigated for use in the new catalyst system. Superacids have an acid strength stronger than 100% sulfuric acid and in the solid form, the catalytic sites are located on the surface of the solid. They allow easy recovery of the reaction products and lower reaction temperatures which contribute to energy savings. By modifying the solid support, the activity, selectivity, and rate of deactivation of the catalyst can be improved. The following four catalyst systems will be studied in both batch and continuous reactors: 1) large pore-sized zeolite catalysts; 2) p-toluenesulfonic acid immobilized on mesoporous silica; 3) supported sulfonated polystyrene matrix; and 4) supported heteropoly acids. Catalyst systems that meet the 95% selectivity standard will be tested in the continuous process.

Progress and Milestones

Year 1:

- At least one catalyst system must be identified that demonstrates at least a 95% selectivity within reasonable process conditions.
- The catalyst must be suitable for continuous process optimization with or without a solvent.

Year 2:

- The catalyst system will be tested with at least 100 hours of continuous operation.
- Processes will be designed that deliver isosorbide of suitable purity and concentration by maintaining catalyst activity and selectivity and meeting economic targets.

Year 3:

- Pilot demonstrations of the technology will be performed.
- Economic models will be developed to determine if the catalyst system delivers performance that is economically-competitive with conventional technology.

Project Partners

Iowa Corn Promotion Board
Des Moines, IA

Pacific Northwest National Laboratory
Richland, WA

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